Module 3. NFTs and metaverses. From its essentials to the latest advances

Overview

The course was developed by WhiteBIT, one of the largest European crypto exchanges and the official cryptocurrency exchange partner of FC Barcelona.

Welcome to module 3 of our comprehensive course on blockchain technologies and cryptocurrencies. In this module, we will delve into a topic that has already secured its significant place in the history of blockchain: NFTs and metaverses. From essential definitions and illustrative examples to the latest advancements, this course is designed to deepen the understanding of the profound impact these innovations have on the development of modern technologies and their cultural significance.

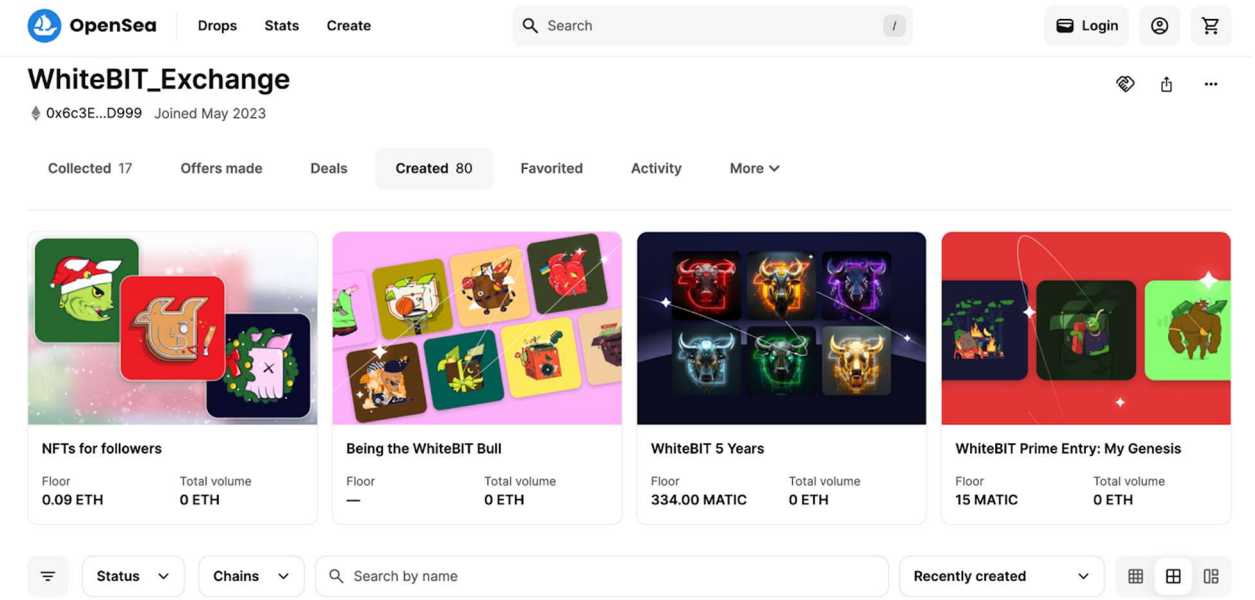
Unit 1. Understanding NFTs and their origins: key definitions and examples

Definition of NFTs

NFTs or non-fungible tokens represent a unique class of digital assets that are indivisible and distinguishable, making each token one-of-a-kind. Unlike traditional cryptocurrencies such as bitcoin or ethereum, which are fungible and interchangeable on a one-to-one basis, NFTs are designed to represent ownership and authenticity of specific digital or physical items.

The concept of NFTs can be traced back to the early days of blockchain technology, with the groundwork laid by projects like coloured coins and Counterparty in the mid-2010s. However, it was only with the introduction of the ERC-721 standard (Entriken *et al*., 2018) on the ethereum blockchain in 2017 that NFTs gained widespread recognition and adoption.

Figure 1. Some NFT from WhiteBIT (M3-U1-1)



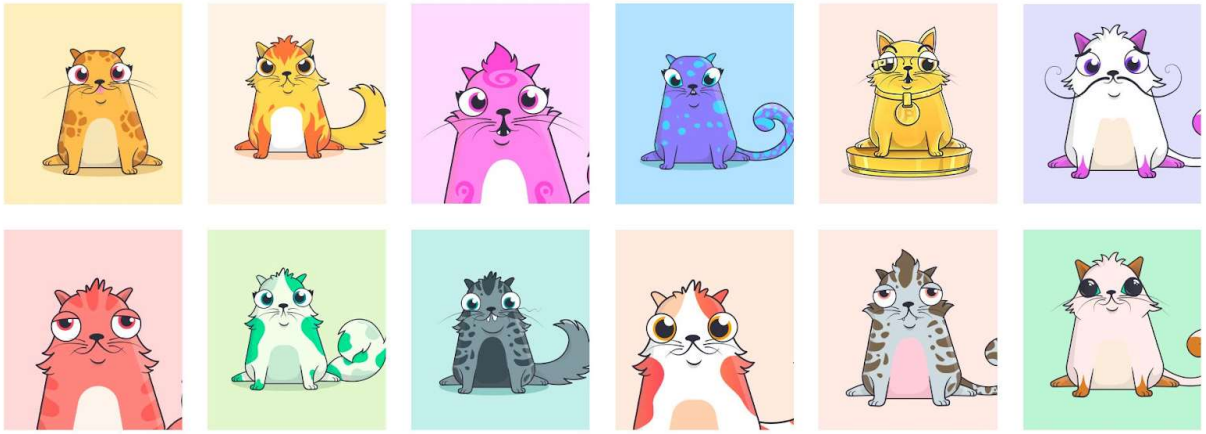
Source: Own Source. Created by the author for this module.

Vivid NFT examples

Cryptokitties

One of the landmark milestones in the evolution of NFTs is the emergence of CryptoKitties in 2017. CryptoKitties is an innovative blockchain-based game that significantly contributed to popularising and showcasing the potential of non-fungible tokens (NFTs). Developed by Vancouver-based blockchain studio Axiom Zen, cryptoKitties introduced a novel concept: digital collectible cats that users could buy, sell, and breed. Each cryptoKitty was represented as a unique NFT, meaning no two virtual cats were identical. The game leveraged the ethereum blockchain's ERC-721 standard (Entriken *et al.*, 2018), enabling the creation of indivisible and distinguishable tokens.

Figure 2. CryptoKtties (M3-U1-2)



Source: [untitled image of criptokitties], (n. d.), https://bit.ly/42S0Gws.

Pepe the Frog

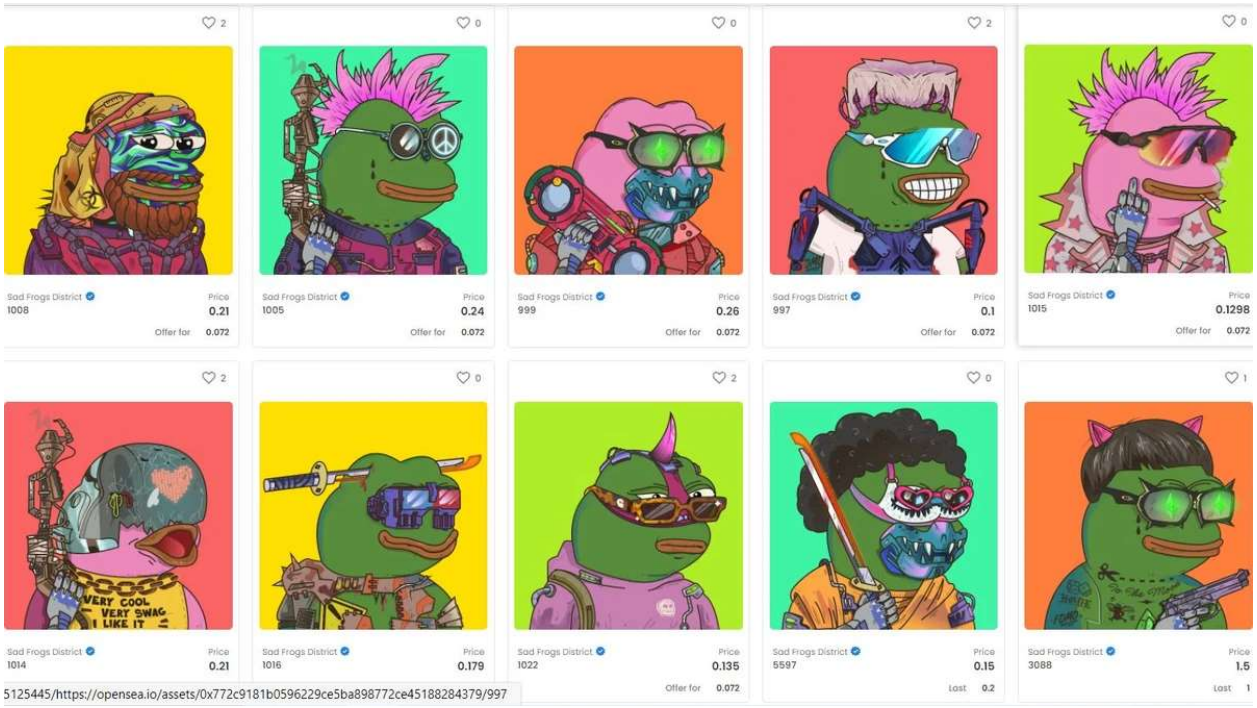
Another well-known example is Pepe the Frog. Initially known as a popular internet meme, Pepe the Frog has undergone a transformative journey into the realm of non-fungible tokens (NFTs), demonstrating the versatility of blockchain technology in reshaping digital culture.

Created by artist Matt Furie in 2005 as part of his comic series *Boys Club*, Pepe the Frog started as a light-hearted and relatable character. Over the years, Pepe gained widespread popularity online, becoming a meme embraced by online communities for expressing various emotions and reactions.

In 2018, the narrative of Pepe's NFT journey expanded with the introduction of Homerpepe, a unique and highly sought-after Pepe variant on the ethereum blockchain. Homerpepe, characterised by a distinctive Homer Simpson-esque appearance, became an iconic representation within the Pepe NFT ecosystem. The rarity and demand for Homerpepe added a new layer to the cultural and economic dynamics of the broader Pepe NFT collection.

At the beginning of 2017, Homerpepe cost $500 in XCP and, a year later, it was already worth $38,500 in PepeCash.

Figure 3. Pepe the Frog (M3-U1-3)



Source: [untitled image of Pepe the Frog], (n. d.), https://bit.ly/42TKqLB.

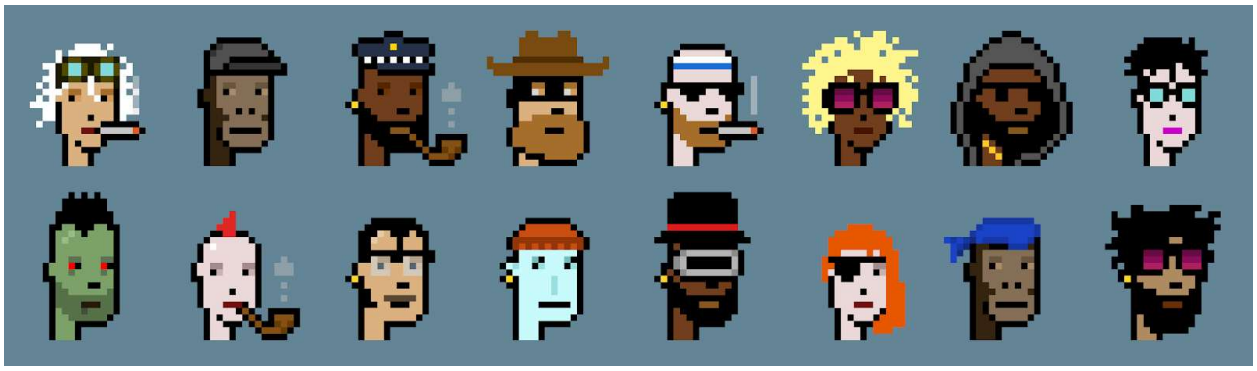
Cryptopunks

In the landscape of non-fungible tokens, one project stands out as a trailblazer and a symbol of innovation: cryptopunks. Created by Matt Hall and John Watkinson of Larva Labs, cryptopunks were one of the earliest experiments with NFTs on the Ethereum blockchain and have left an indelible mark on the development of NFT technology.

Cryptopunks are the first NFTs created and traded on the ethereum blockchain. As early movers in the NFT space, they laid the groundwork for the ERC-721 standard (Entriken *et al.*, 2018), which later became the industry standard for creating unique, indivisible tokens. This standardisation paved the way for the explosive growth of the broader NFT ecosystem.

The success and influence of cryptopunks extend beyond their value as collectibles. They inspired countless projects and creators to explore the possibilities of NFTs, contributing to the diversification of the NFT ecosystem. The lessons learned from cryptopunks, such as the importance of scarcity and community engagement, continue to shape the strategies of NFT projects today.

Figure 4. Cryptopunks (M3-U1-4)



Source: [untitled image of cryptopunks], (n. d.), https://bit.ly/3TeQICk.

Types on NFTs

NFTs have found applications in various industries, such as gaming, sports, music, and collectibles. Their potential to create new forms of ownership and value in the digital world has made them the subject of significant interest and investment.

Art collectibles

NFTs can represent ownership of unique digital artwork, photographs, or physical collectibles such as sports memorabilia. As a well-known example, we can talk about Beeple's *Everydays: The First 5000 Days*.

Figure 5. Everydays: The First 5000 Days (M3-U1-5)

Source: [untitled image of Everydays: The First 5000 Days], (n. d.), https://bit.ly/49t9ivX.

It is a groundbreaking NFT (non-fungible token) art piece created by the digital artist Mike Winkelmann, known professionally as Beeple. The art piece is a digital collage composed of 5,000 individual images, each designed by Beeple every day over 13.5 years. *Everydays: The First 5000 Days* sold for a staggering $69.3 million, making it one of the most expensive NFTs and contemporary artworks ever sold.

Gaming

NFTs in gaming offer players actual ownership of in-game assets. These assets can include characters, weapons, and other items bought, sold, and traded on blockchain-based marketplaces.

Real estate

NFTs (non-fungible tokens) have begun to impact on the real estate industry, offering a new way to represent ownership and transfer of property digitally. Examples include Decentraland, The Sandbox, Mattereum, and many others.

Music

Musicians and artists can use NFTs to sell and distribute music, providing fans unique digital collectibles. For example, DJ 3LAU sold a digital album as an NFT for $11.6 million, making it one of the most significant NFT sales in the music industry.

Films and video content

NFTs have entered the film industry, enabling creators to tokenise and sell digital content. This provides a new revenue stream and allows fans to own exclusive copies. For example, we can mention Beeple and his animated short film *Crossroads* and NBA Top Shot, offering NFTs of memorable basketball moments.

Domain names

Domain names can now be represented as NFTs on the blockchain. This enhances the security and transferability of digital assets associated with domain ownership. For instance, ENS (Ethereum Name Service) allows users to register and trade blockchain-based domain names as NFTs.

Tickets

NFTs for event tickets provide a secure and traceable way to verify authenticity. They can also include additional perks or access to exclusive content or experiences.

PFP (profile pictures) and avatars

NFTs have become a form of personal expression online, with users buying, selling, and displaying unique profile pictures and avatars as status symbols, such as, Bored Ape Yacht Club features hand-drawn ape avatars with exclusive membership perks.

Collectibles and memorabilia

NFTs extend to sports memorabilia, allowing fans to own digital representations of iconic moments, athletes, and collectibles from their favourite sports. Some examples of this are NBA Top Shot's NFTs of basketball collectibles, including iconic slam dunks and player highlights.

Such NFTs can be created and presented to users as part of promo activities. For example, every new user of the WhiteBIT crypto exchange can receive a branded NFT to mark their joining the community of one of the biggest cryptocurrency exchanges in the world. Read more detailed information on the WhiteBIT Blog (WhiteBIT, 2023a).

Utility tokens and membership

Membership NFTs grant access to exclusive communities, forums, and events or provide special privileges. They act as digital keys to unlock various benefits within a community. Examples: membership NFTs for exclusive forums, discord channels, or virtual spaces.

Interactive and dynamic NFTs

Some NFTs go beyond static images and are algorithmically generated or interactive. These dynamic NFTs can change over time or respond to external inputs. Examples: Art Blocks, a platform for creating generative art that allows users to mint unique, algorithmically generated NFTs.

These examples showcase the incredible diversity and impact of NFTs across various industries, transforming how we perceive, own, and interact with digital assets.

Topic 2: The way an NFT is arranged and how to create a non-fungible token

Non-fungible tokens (NFTs) represent unique digital assets that derive their uniqueness and ownership verification from the underlying technology of blockchain. The blockchain serves as a decentralised and secure ledger that records transactions, and smart contracts, which are self-executing contracts with coded terms, play a crucial role in the creation and management of NFTs.

Smart contracts, the building blocks of blockchain technology, enable the creation and execution of NFTs. These contracts are programmable and self-executing, meaning they automatically enforce the terms encoded within them. When applied to NFTs, smart contracts define the rules for creating, transferring, and owning these unique digital assets. They provide automation and trust in the digital realm, ensuring that the terms governing NFTs are transparent, immutable, and tamper-proof.

Protection from counterfeiting

One of the critical advantages of using smart contracts in NFTs is the protection they offer against counterfeiting. Each NFT is assigned a unique identifier and metadata stored on the blockchain.

Verification of rightful ownership

Smart contracts also facilitate the verification of rightful ownership in the NFT space. The ownership of an NFT is recorded on the blockchain, creating a transparent and publicly accessible ledger.

Blockchain platforms

Various blockchain platforms serve as the infrastructure for NFT creation and management. Ethereum, known for pioneering NFTs with its ERC-721 standard (Entriken *et al.*, 2018), remains dominant. Platforms like Solana, Polygon, Tezos, and more, have emerged, offering unique features and benefits.

NFT metadata

Metadata is pivotal in non-fungible tokens as the informational backbone that encapsulates details about each token's unique characteristics and properties. Essentially, metadata can be understood as data that describes or provides additional information about another data set. In the context of NFTs, this supplementary data is crucial for identifying, distinguishing, and contextualising the digital assets represented by the tokens.

As an illustrative example, consider a digital artwork represented as an NFT. The metadata associated with this NFT includes details such as the artwork's title, the artist's name, the year of creation, a brief description, and links to high-resolution images or videos showcasing the piece. This information enhances the viewer's appreciation of the artwork and provides critical provenance and context for potential buyers or collectors.

Dynamic and static metadata

Dynamic and static metadata represent distinct categories of information that can be linked to a non-fungible token (NFT), contributing to the comprehensive understanding and classification of these unique digital assets.

Static metadata

Static metadata pertains to information established during NFT creation and remains unalterable. This fixed set of details provides a foundational snapshot of the token, capturing essential attributes that define its inherent characteristics. Examples of static metadata include the initial creation timestamp, the unique identifier assigned to the NFT, and other immutable features contributing to its identity. This unchanging information is a permanent record, offering a historical context consistent throughout the token's existence.

Dynamic metadata

In contrast, dynamic metadata is characterised by its capacity to be modified or updated after the NFT's creation. This type of information enables adaptability and responsiveness to changes or evolutions in the digital asset context. Dynamic metadata can include real-time data, updates on the NFT's ownership history, or alterations to descriptive details that reflect the evolving narrative of the token. For instance, if an NFT is associated with an ongoing series of digital artworks, dynamic metadata might encompass adding new pieces to the collection or updating the artist's commentary.

Interplay between dynamic and static metadata

Dynamic and static metadata interplay creates a nuanced and layered profile for each NFT. Static metadata forms the bedrock, providing a foundational understanding of the token's origin and core attributes. Meanwhile, dynamic metadata introduces a temporal dimension, allowing the NFT to adapt, grow, and reflect changes in its lifecycle, ownership, or contextual relevance.

Examples of metadata elements

1. Static metadata: initial creation timestamp, NFT identifier, artist's name, and the original title of the artwork.
2. Dynamic metadata: real-time ownership updates, additions to an evolving digital collection, changes in contextual information, or modifications to the artist's commentary.

Non-fungible tokens with random attributes

NFTs with random attributes introduce an intriguing dimension to the digital asset landscape, offering each token a unique and unpredictable quality. In this innovative paradigm, the characteristics of these NFTs are not pre-determined, but are dynamically and randomly generated, adding an element of chance and variability to their features.

In-game collectibles

One notable application of NFTs with random attributes is in the realm of in-game collectibles. These digital assets, which could be characters, items, or artifacts within a virtual game environment, possess attributes that are entirely generated at random. For instance, an in-game creature may have unpredictable attributes like strength, speed, or special abilities, introducing an element of surprise and diversity to the gaming experience. Players are collectors and explorers of the unique combinations and permutations of attributes that each NFT can possess.

Randomly generated digital art

Similarly, random attribute NFTs extend their creative reach into the domain of digital art. Digital art can be crafted with randomly generated elements, such as colours, patterns, or shapes. This introduces an element of serendipity into the artistic process, in which the artist relinquishes control over certain aspects, allowing the digital creation to take on unexpected and unique forms. Collectors then acquire a piece of art and a singular configuration of visual elements that emerged unpredictably during the creation process.

Expanding the creative spectrum

NFTs with random attributes redefine the boundaries of creativity, fostering a dynamic and ever-evolving artistic landscape. Randomness introduces an inherent unpredictability, challenging traditional notions of artistic control and intention. This dynamic approach extends beyond the static nature of conventional digital assets, transforming creation into a collaborative dance between human intent and algorithmic serendipity.

Blockchain validation

Crucially, the randomness and uniqueness of these attributes are secured through the blockchain. The blockchain is an immutable ledger, ensuring that the randomly generated features associated with each NFT are verifiable, transparent, and tamper-proof. This adds a layer of trust to the NFT ecosystem, assuring collectors of authenticity and integrity.

NFT standards

Standards are crucial in non-fungible tokens (NFTs), establishing guidelines and frameworks that facilitate interoperability, compatibility, and seamless interactions within blockchain ecosystems. Here are some prominent NFT standards, each tailored for specific blockchain platforms.

ERC-721 (Ethereum)

The ERC-721 standard (Entriken *et al*., 2018) is a cornerstone in the NFT space, specifically designed for the ethereum blockchain. It empowers developers to create unique and distinct tokens, each with its properties.

ERC-1155 (Ethereum)

Building upon the ERC-721 standard, ERC-1155 (Radomski *et al*., 2018) introduces a versatile approach to tokenisation. It enables the creation of multiple types of tokens within a single smart contract, fostering efficiency and flexibility. Furthermore, ERC-1155 supports tokens with varying characteristics, allowing a diverse range of digital assets to coexist within the same contract. This standard has found utility in gaming, in which a single contract can manage different in-game assets, each with unique attributes.

TRC-721 (TRON)

On the TRON blockchain, TRC-721 serves as the standard for non-fungible tokens. Like ERC-721, it enables the creation of unique and distinguishable tokens, particularly suited for applications in the TRON ecosystem. This standard is pivotal in developing digital collectibles, gaming assets, and other unique items on the TRON blockchain.

The way to create an NFT

Creating a non-fungible token (NFT) involves several steps, from choosing the blockchain platform to minting the token and adding metadata. Here is a general guide on how to create an NFT:

1. **select a blockchain**. Pick a blockchain platform that supports NFTs. Ethereum is the most popular platform, but others like Polygon, Solana, and Flow are gaining traction. Each platform has advantages, such as different transaction fees and environmental considerations.

2. **Set up a wallet**. Get a digital wallet compatible with the chosen blockchain. The wallet is essential for storing and managing your NFTs. Some examples of this are MetaMask for Ethereum.

3. **Fund your wallet**. Add cryptocurrency to your wallet to cover transaction fees and minting costs. Ensure you have enough funds to cover gas fees (Ethereum) or transaction fees (other blockchains).

4**. Create Digital Art or Content.** Generate the digital content you want to tokenise as an NFT. This could be digital art, music, videos, virtual real estate, or any other digital asset. Ensure the content adheres to the specifications of the chosen platform.

5. **Minting the NFT**. Minting is the process of creating an NFT. The steps may vary depending on the blockchain platform, but you will generally need to visit an NFT marketplace or use a dedicated minting platform. Some blockchains, like Ethereum, require you to interact with a smart contract to mint an NFT.

6. Upload and add metadata. When minting, you will usually need to upload your digital file and add metadata. Metadata includes information about your NFT, such as title, description, and other relevant details. This metadata is often stored on the blockchain and can be viewed by potential buyers.

7. Set royalties and permissions. Some platforms allow you to set royalties, determining the percentage of the resale value you receive when the NFT is sold by someone else. Consider the royalties you want to set and any permissions associated with your NFT.

8. Confirm and pay fees. Review the details of your NFT, confirm the minting process, and pay any associated fees. Be aware of gas fees on Ethereum, as they can vary depending on network activity.

9. Wait for confirmation. After confirming the minting process, you may need to wait for the blockchain network to process the transaction and confirm the creation of your NFT. Depending on the blockchain's speed, this process can take a variable time.

10. View and share your NFT. Once confirmed, your NFT is live on the blockchain. You can view it on the NFT marketplace in which you minted it. Share the link to your NFT with others or list it for sale on NFT marketplaces.

Remember that the specific steps and details may vary based on your chosen blockchain and platform. Always check the guidelines and requirements of the selected marketplace or minting platform. Additionally, consider the environmental impact and sustainability of your blockchain platform chosen.

Topic 3: Discovering NFT marketplaces

NFT marketplaces are online platforms that facilitate the creation, buying, selling, and trading of non-fungible tokens. Like exchanges, these trading platforms can be centralised or decentralised. They can be both general and niche, in which they only sell works of art, game items, or trading cards.

Key features and aspects of NFT marketplaces include:

- **Smart contracts**. NFT marketplaces often use self-executing smart contracts with coded terms to automate and secure transactions. Smart contracts play a crucial role in creating, transferring, and verifying NFT ownership.

- **Creation and minting**: artists and creators can mint NFTs by converting digital or physical creations into unique tokens. Minting involves the creation of a new token, assigning properties and metadata, and recording it on the blockchain.

- **Buying and selling**: users can buy and sell NFTs using cryptocurrency, usually ethereum, within these marketplaces. The ownership transfer is recorded on the blockchain, ensuring transparency and traceability.

- **Royalties**: NFTs often incorporate royalty mechanisms, enabling creators to receive a percentage of the resale value every time their token changes hands. This feature provides ongoing support for artists and content creators.

- **Interoperability**: some NFT marketplaces allow users to trade tokens across different platforms. This enhances liquidity and expands the market for NFTs.

- **Curation and discovery**: NFT marketplaces typically offer tools for curation and discovery, allowing users to explore and find NFTs based on their preferences. This includes featured collections, search filters, and trending categories.

Notable examples of NFT marketplaces include OpenSea, Rarible, Mintable, and NBA Top Shot. The popularity of NFTs has surged in various industries, attracting artists, musicians, gamers, and collectors who seek to engage with and own unique digital assets in the form of NFTs.

Here is what is needed to start using an NFT marketplace:

- a crypto wallet;
- cryptocurrency in the wallet;
- an account on the platform you will be using.

Remember, most marketplaces charge a fee for token creation and listing.

Primary and secondary sales on NFT marketplaces

Primary sales refer to the artist or creator's initial creation and sale of NFTs. This is when the digital asset is minted (tokenised) and offered for sale on an NFT marketplace for the first time.

Buyers in primary sales usually purchase directly from the artist or creator of the NFT. The creator sets the initial price and terms for the sale. Creators often include royalty percentages in the smart contract code. This means they receive a percentage of subsequent sales whenever the NFT is resold in secondary markets.

Secondary sales involve the resale of previously purchased NFTs. Once someone buys an NFT in a primary sale, they can sell it to someone else in the secondary market.

In secondary sales, ownership of the NFT is transferred from the original buyer to a new buyer. The transaction occurs between users, and the creator typically does not receive a direct share of the resale amount. While creators do not directly benefit from secondary sales, most NFT marketplaces implement a royalty system for secondary transactions. A percentage of the resale amount goes back to the original creator as a royalty, providing ongoing support for the artist.

The way NFTs marketplaces work

When selling NFTs, creators and owners can choose between two primary methods: fixed-price listings and auctions. Each method has its dynamics and advantages, catering to different preferences and strategies within the NFT marketplace.

Fixed-price listings

The NFT is offered for sale at a predetermined price in a fixed-price listing. The seller decides on the price that they believe it reflects the value of the NFT. This price can be based on factors, such as the perceived uniqueness of the digital asset, the creator's reputation, and market demand. Interested buyers can instantly purchase the NFT at the listed price without needing a bidding process. Once a buyer makes the purchase, ownership of the NFT is immediately transferred to the buyer's wallet.

Auctions

Auctions introduce a competitive and time-bound element to the sale of NFTs, allowing potential buyers to place bids within a specified timeframe. The seller sets a minimum bid amount, acting as the starting point for the auction. Bidders must place bids equal to or higher than this minimum. The NFT is open for bidding during a predefined period, which could range from hours to days. Participants compete by placing bids on the NFT, gradually increasing the highest bid.

Minimum price in auctions

In auction-style listings, a minimum price is established by the seller. This minimum serves as the initial bid that participants must meet or exceed. The seller sets a floor price to ensure that the bidding starts at a level they find acceptable. Bidders cannot place offers below this minimum. While auctions introduce a competitive element, the minimum price safeguards sellers, preventing the NFT from being sold at an unreasonably low value.

Both fixed-price listings and auctions contribute to the diverse and dynamic nature of the NFT market, accommodating various preferences and strategies for both creators and collectors. The choice between these methods depends on factors such as the nature of the NFT, the goals of the seller, and the desired level of engagement with the audience.

Definition of royalties

In NFTs, royalties represent a percentage of the resale price allocated to the original creator each time the token changes hands. This mechanism ensures that creators can continuously benefit from their work, extending beyond the initial sale.

For instance, if an NFT is initially sold for $100 with a 5% royalty, the creator receives $5 every time the NFT is resold. The author can set the percentage designated as royalties or subject to negotiation between the buyer and the seller.

Beyond being a means for creators to profit post-initial sale, royalties play a crucial role in fostering a vibrant market for non-fungible tokens. By offering a fair reward, royalties incentivise the creation and circulation of high-quality NFTs, contributing to the overall health and sustainability of the NFT ecosystem.

Types of royalties

Types of royalties in the context of NFTs feature diverse structures, illustrating the flexibility in compensation models:

- **fixed royalty rate**. This structure involves a predetermined amount paid to the NFT creator with each resale. Often expressed as a specified percentage of the sale price, such as 7%.
- **Progressive royalties**: this model entails incrementally increasing royalties corresponding to the selling price of the NFT. For example, it commences at 8% for the initial resale and gradually escalates to 12% for subsequent resales.
- **Multi-level royalties**: this approach integrates distinct royalty rates tailored to different price brackets. For instance, 6% for sales up to $150, 11% for sales between $150 and $700, and 16% for sales surpassing $700.

- **Performance-based royalties**: these royalties are linked to specific achievements or milestones, such as engagement metrics like views or downloads. While less common, they hold relevance for categories of artworks, like videos or music.

Topic 4: Definition of fan tokens. Differences with NFTs

Fan tokens represent a unique form of engagement and interaction between fans and sports teams, music clubs, or other organisations. These digital assets, distinct from NFTs, offer holders various membership perks, including voting on club decisions, exclusive rewards, merchandise designs, and special experiences. Unlike NFTs, fan tokens are fungible, making them interchangeable like traditional currency, enabling fans to exchange them for club merchandise and VIP experiences.

These tokens play a pivotal role in fostering community spirit, providing fans with an additional team-branded element of fandom. While not backed by the underlying principles of major cryptocurrencies like bitcoin or ethereum, fan tokens derive their value from fans' desire to participate in the club and actively receive unique benefits.

The Chiliz token is a notable pioneer in the fan token space, leading to the emergence of tokens such as Manchester City Fan Token, AC Milan Fan Token, and Juventus Fan Token. These tokens represent a novel use case for crypto, showcasing innovation in the blockchain space.

FC Barcelona fans now have the exciting opportunity to acquire Barça Fan Tokens [BAR] (FC Barcelona, 2020). This digital asset allows them to actively participate in surveys and polls related to the daily affairs of the club. Issued by blockchain company Chiliz, one of FC Barcelona's esteemed partners, these tokens open the door for supporters to influence decisions, starting with voting on the design of the new mural adorning the first team locker room. Fans worldwide can propose different designs, bringing the winning choice to life. The $BAR tokens can only be purchased through Chiliz.net or Socios.com, the dedicated voting site. Chiliz hosted a limited flash sale of 600,000 fan tokens at a fixed price of two euros each for the first forty-eight hours to commemorate the launch. Apart from the voting privileges, token holders stand to earn exclusive rewards, including digital experiences and real-life opportunities, such as meeting players before a game or enjoying a match live as a VIP guest at the iconic Camp Nou. This innovative initiative creates a unique bridge between FC Barcelona and its passionate fan base, fostering engagement and providing unprecedented access to the club's inner workings.

Figure 6. FC Barcelona fan token (M3-U1-6)

Source: [untitled image of FC Barcelona fan token], (n. d.), https://bit.ly/3TcaePC.

Fans can acquire and trade these digital tokens like other cryptocurrencies. The seller typically sets the price of a fan token and is subject to market dynamics and token popularity. Upon owning a certain amount of fan tokens, users gain voting rights on various club-related matters, including merch design, tour bus designs, ticketing, match locations, and MVP categories. This engagement enhances fans' connection with the club, adding pride and prestige as their tokens potentially appreciate value over time.

Fans can acquire CHZ (Chiliz native token) to purchase fan tokens via a crypto exchange, and some fan tokens exist outside the Chiliz platform. These tokens, specific to a team or club, provide access to encrypted voting and membership rights ledgers.

Fan tokens are unique digital assets within fan clubs and sports organisations, differing from traditional cryptocurrencies like ethereum or chainlink. They focus on fun and rewards, providing an interactive and exclusive community experience for dedicated fans. Examples of fan tokens span various domains, including sports and music, such as KPOP Fan Token, Professional Fighters League Fan Token, Paris Saint-Germain Fan Token, FC Barcelona Fan Token, and Galatasaray Fan Token.

Unit 2. NFTs function

Topic 1. Art and beyond: NFTs' function

Non-fungible tokens (NFTs) extend their utility beyond the realms of art, fashion, games, and virtual real estate. They find diverse applications in digital identity, crowdfunding, charity, digital property rights, and financial transactions.

Digital identity

NFTs serve as representations of digital identity across various domains. Beyond avatars, they encompass virtual real estate, tickets, certificates, domain names, community access, and even voting rights within DAOs (decentralised autonomous organisations). In this context, a digital identity can be a creative expression that may or may not mirror the holder's real-life persona.

Crowdfunding

NFTs have transformed crowdfunding by introducing new avenues for raising capital. Projects and initiatives can create NFTs representing ownership or exclusive benefits, allowing backers to support a cause while gaining tangible, tradable assets. This novel approach provides a more engaging and actual connection between creators and their supporters, fostering a new era of decentralised crowdfunding.

Charity

NFTs have made significant strides in the charitable sector. Charities can tokenise unique digital or real-world assets, creating NFTs representing donations. Contributors receive NFTs as proof of their support, and the transparent nature of blockchain ensures accountability in the distribution of funds. This innovative use of NFTs adds transparency and traceability to charitable contributions.

Digital property rights

NFTs are revolutionising the concept of digital property rights. Artists, musicians, and content creators can tokenise their work, establishing ownership and authenticity through NFTs. This extends to digital real estate within virtual worlds, in which NFTs represent ownership of virtual spaces or items. The blockchain ensures the provenance and scarcity of these digital assets, fostering a new era of ownership and monetisation.

Finances

Beyond their role in buying and selling, NFTs can serve as loan collateral. Decentralised finance (DeFi) platforms facilitate such transactions, regulating terms and rates through smart contracts. This innovative use of NFTs adds a financial dimension to their functionality, giving holders additional options to leverage their digital assets.

In summary, the versatility of NFTs extends far beyond the traditional domains, opening new possibilities in digital identity, fundraising, charity, property rights, and financial transactions. As the NFT ecosystem evolves, these diverse applications contribute to its growing significance in various sectors.

Topic 2: Metaverses and the virtual economy. NFTs, DAOs and DeFi in the metaverse

The metaverse, a burgeoning concept, serves as a virtual space in which users engage with each other and with virtual elements, fostering an immersive digital environment. It finds application across various domains, including gaming, education, communication, and social networking. In metaverses, users embody virtual avatars, constructing virtual structures, forming organisations, joining groups, and fostering interactions.

Find more comprehensive information in the following article:

Source: **WhiteBIT**. (4 de noviembre de 2022a). *What Is the Metaverse*. WhiteBIT. https://blog.whitebit.com/en/what-is-the-metaverse/.

Distinguishing features

Unlike augmented reality (AR) and virtual reality (VR), the metaverse is not confined to one technology: it integrates both AR and VR. AR enhances the real world by incorporating virtual elements through mobile device cameras or specialised devices like AR glasses, as the popular Pokémon GO game exemplifies. Conversely, VR enables users to immerse themselves entirely in a virtual environment using headsets.

User interaction and evolution

Metaverse users leverage AR and VR technologies to shape their narratives and explore the digital realm freely. Although metaverse avatars may exhibit a degree of simplicity, technological advancements continually refine their appearance and capabilities. The overarching objective is to create a dynamic world in which users can seamlessly engage in activities mirroring real-life experiences, encompassing play, work, communication, relaxation, and creativity.

Virtual reality (VR) and the metaverse are related concepts, but they refer to different aspects of digital experience. Next, there is a breakdown of the key differences.

Table 1. Key differences between the metaverse and virtual reality

	Metaverse	**Virtual reality**
Scope and connectivity	The metaverse is a broader and more interconnected concept. It goes beyond individual VR experiences, encompassing a shared collective space in which users can seamlessly move between virtual environments. The metaverse is characterised by its extensive connectivity.	VR typically refers to immersive, computer-generated environments that users can interact with using specialised hardware like VR headsets. VR experiences are often self-contained and may not be inherently interconnected.
Interactivity and persistence	The metaverse emphasizes persistent virtual spaces that exist continuously, irrespective of whether individual users are actively engaged. Changes made by users or events within the metaverse can affect the experiences of others, fostering a more dynamic and interconnected environment.	VR focuses on creating immersive and interactive digital environments. Even if these environments may persist during a session, they are often separate.
Applications	The metaverse has a more extensive range of applications beyond entertainment. It spans education, business meetings, socialising, virtual events, e-commerce, and other collaborative and interactive experiences.	VR is commonly associated with gaming and entertainment, but it has applications in various fields, including training, simulations, and virtual tourism.

Decentralisation	Some visions of the metaverse involve decentralised architectures, using blockchain or other distributed technologies. This decentralisation can enable ownership of digital assets, secure transactions, and establish a user-driven economy.	VR experiences are often created and controlled by centralised entities, such as game developers or technology companies.

Source: own source.

Decentralisation in metaverses

The decentralisation of metaverses is a pivotal consideration, differentiating between centralised and decentralised approaches. Meta's centralised model, for instance, raises concerns as the company acts as an intermediary with the ability to control and potentially restrict user profiles within the metaverse.

Blockchain's role in metaverses

Blockchain is foundational for creating a decentralised metaverse, addressing central authority issues. It brings several transformative benefits to the metaverse ecosystem:

1. decentralisation. Blockchain facilitates the development of decentralised virtual worlds, enabling user interactions and asset engagements without reliance on a central authority.

2. Ownership and transfer of virtual assets: virtual assets within the metaverse can be represented as unique non-fungible tokens (NFTs) on the blockchain. This innovation allows for transparent ownership and seamless transfer of virtual assets, fostering virtual economies and markets.

3. In-game economies: blockchain technology enables tokenising in-game assets, allowing their trade outside the gaming environment. This opens new avenues for virtual economies and financial products associated with gaming.

4. Interoperability: different metaverses can be interconnected, allowing users to transition between virtual worlds without altering their assets or identities. Blockchain ensures seamless interoperability.

5. Identification and authentication: blockchain enhances security in the metaverse by managing user identities securely.

Examples of blockchain integration in metaverses

Several metaverses showcase successful integration with blockchain technology:

- Atlantis World. This metaverse employs blockchain to construct a social environment on Web3, providing users with an exploratory game and rewarding quests.

- Decentraland: users create, consume, and monetise content within this virtual metaverse. The Blockchain manages virtual assets, identities, and facilitates virtual commerce.

- Axie Infinity: as a decentralised game, Axie Infinity leverages blockchain to establish a virtual economy and marketplace for in-game assets and creatures.

- Sandbox: in this decentralised virtual world, users can create and monetise their gaming opportunities. Blockchain manages virtual assets, identities, and supports virtual commerce.

- Cryptovoxels: built on ethereum, Cryptovoxels enables users to manage virtual assets, own virtual real estate, attend events, and participate in games.

Metaverse and virtual economy

Metaverses, functioning as platforms for virtual interaction and content creation, have evolved into hubs for online commerce, advertising, and various virtual services. According to Citi Global Perspectives & Solutions prognosis (Citi, 2022), the metaverse market is projected to have 5 billion users and reach $13 trillion by 2030, transforming business opportunities and reshaping economic perspectives.

FC Barcelona, one of the most influential football clubs in Spain and Europe, has announced its intention to expand into new business areas, including the metaverse and NFT. The expansion aims to increase the club's engagement through these new technologies. Joan Laporta hinted at the possibility of launching a cryptocurrency issued by the club itself to complement the already available fan token issued in partnership with Socios. The club is already building the infrastructure to support this new path with the

launch of Barça Studios to centralise the production of all the team's audiovisual offerings, as well as the Barça Innovation Hub to bring new technologies into the team's workflow.

Furthermore, FC Barcelona has introduced its first NFT, presenting an audiovisual digital creation that captures the historic moment at the Johan Cruyff Stadium on December 22, 1973. This iconic piece revisits the legendary scene in which the renowned Dutch player soared through the air, securing the decisive goal against Atlético Madrid goalkeeper Miguel Reina.

Figure 7. *In a Way, Immortal*, the first NFT in the club's history FC Barcelona (M3-U2-1 FC)

Source: [untitled image of the first NFT in the club's history FC Barcelona], (n. d.), https://bit.ly/49RnmiN.

The NFT serves as a unique and collectible representation of this pivotal chapter in FC Barcelona's history, allowing fans and collectors alike to own a digital artifact that encapsulates the magic of that memorable day. This innovative initiative by FC Barcelona adds a new dimension to the world of sports memorabilia, blending cutting-edge blockchain technology with the rich narratives of football's storied past.

In a Way, Immortal is the first NFT in a collection of ten pieces that will be unveiled one at a time over the coming months, each depicting iconic moments and figures from FC Barcelona, highlighting the Club's legacy (FC Barcelona, n. d.).

NFTs, DAOs, and DeFi in the metaverse

- NFTs: NFTs serve as proof of ownership for virtual assets, including real estate and art, enhancing the authenticity and tradeability of virtual possessions within metaverses.

- DAOs: Decentralised autonomous organisations provide a governance structure for the metaverse, empowering participants to make decisions, allocate resources, and fund projects for development.

- DeFi: decentralised finance in the metaverse organises a virtual economy, enabling the creation of virtual currencies, real estate markets, art markets, and various services.

Significance of metaverses

Games: metaverses, such as Atlantis World, offer a dynamic gaming environment in which users engage in quests with rewards, exemplifying a widespread use case for the metaverse.

Social interaction: platforms like Somnium Space turn the metaverse into a hub for social interaction, allowing users to own, develop, and explore virtual real estate while hosting virtual events.

Virtual real estate: metaverses allow users to own and build virtual real estate, fostering creativity and entrepreneurship. Platforms like The Sandbox enable users to buy, develop, and monetise virtual land.

In essence, metaverses are not merely confined to gaming, but they extend into diverse realms, encompassing social interaction, virtual real estate ownership, and the creation of dynamic virtual economies. Blockchain technologies are fundamental in realising the decentralisation, security, and interoperability required to evolve metaverses.

Topic 3: Metaverse as a social network

Decentralised social networks

The prevalent social networks of today operate under the Web 2 paradigm, allowing interactions such as commenting, content creation, and sharing. While Web 2 has increased user freedom, it lacks true anonymity and independence from a central governing body. Decentralised networks, operating on the principles of blockchain, aim to usher in digital democracy by eliminating centralised control.

Imagine being a content creator reliant on a platform for income, only to face account blocks, bankruptcy, or hacking incidents by the controlling company. In decentralised social networks, there is no central authority or data storage. Blockchain-based networks

empower users to retain control over their data, appealing to those seeking data ownership and online security. Activists, journalists, and individuals working with sensitive information are particularly drawn to these networks to safeguard their privacy and free speech rights.

Metaverse as a social network

Metaverses, designed for gaming, learning, and work, inherently facilitate user interaction. In this context, social networks can seamlessly exist within metaverses, offering a more immersive and experience-focused alternative.

Metaverses are evolving into a novel form of social network, enhancing interactivity and immersion in virtual reality. This metaverse social network amalgamates familiar social network elements such as collaboration, commerce, and events while introducing innovative features like crypto wallets and NFTs.

This evolution could signify the future of social networks, elevating user interaction to a new level, and transcending traditional 2D applications in favour of fully immersive 3D worlds. It goes beyond mere text exchanges in messaging apps, transforming interactions into virtual walks and meetings, redefining the essence of social connectivity.

In essence, the metaverse as a social network introduces a paradigm shift, enriching user experiences and interactions, thereby shaping the trajectory of social networking toward a more immersive, three-dimensional future.

Challenges of decentralised social networks

While decentralised social networks promise enhanced privacy and user control, they face several challenges that need thoughtful solutions for widespread adoption.

1. Complex interface: the transition from familiar, user-friendly Web 2 platforms to decentralised networks often involves a steeper learning curve. Users accustomed to the seamless interfaces of centralised platforms may find the decentralised counterparts more intricate. Improving user experience and simplifying interfaces are crucial for the broader acceptance of decentralised social networks.

2. Feature limitations: decentralised networks might offer fewer features than their centralised counterparts in their current state. Web 2 platforms have evolved over the years, accumulating a plethora of functionalities. For decentralised networks to compete effectively, developers must focus on expanding feature sets without compromising the principles of decentralisation.

3. Scalability issues: scalability remains a significant hurdle for decentralised social networks. As user bases grow, blockchain networks can face congestion, leading to slower transaction speeds and increased costs. Implementing solutions like layer-two scaling or innovative consensus mechanisms ensures decentralised networks can handle large user volumes seamlessly.

4. User adoption and education: educating users about the benefits and functionalities of decentralised social networks is vital. Increased awareness can help users appreciate the value of decentralised systems, potentially overcoming resistance to change. Moreover, efforts to streamline onboarding processes and provide user-friendly guides can facilitate smoother transitions.

Addressing these challenges requires collaboration between developers, the community, and users. Continuous innovation, user education, and a commitment to improving the overall user experience will be instrumental in overcoming these hurdles and establishing decentralised social networks as viable alternatives in the digital landscape.

Topic 4. GameFi: revolutionising the intersection of gaming and finance

GameFi stands as a dynamic subset within the decentralised finance (deFi) landscape, ingeniously melding blockchain technology with elements of game theory. This innovative approach enhances interest in specific blockchain projects and fosters a deeper connection between users and a particular cryptocurrency.

Play-to-earn (P2E): a game-changing business model

At the heart of the GameFi ecosystem lies the play-to-earn (P2E) business model, offering gamers tangible incentives for their time and skills. Incentives often include in-game cryptocurrencies and non-fungible tokens (NFTs), providing players with assets that hold real-world value, and encouraging active participation and engagement.

Play-to-earn, in the context of GameFi, refers to a gaming model in which players can earn real-world value or cryptocurrency by actively participating in and contributing to a game's ecosystem. This concept is a pivotal element in the intersection of gaming and decentralised finance (DeFi). Here is how it typically works:

- **in-game rewards**. Players receive rewards in the form of cryptocurrency or tradable in-game assets for completing tasks, achieving milestones, or simply spending time in the game.

- **Tokenisation of in-game assets**: virtual items, characters, or other in-game assets are often tokenised as non-fungible tokens on the blockchain. This gives players true

ownership of these assets, allowing them to buy, sell, or trade them both within and outside the game.

- **Decentralised economy**: play-to-earn games often incorporate decentralised economic systems. Players can use their earned tokens to participate in decentralised finance activities, such as staking, lending, or yield farming, creating additional opportunities to grow their in-game earnings.

- **Leveling the playing field**: play-to-earn models aim to distribute rewards more equitably among players. Instead of relying on traditional models in which only a few might benefit, all participants have the potential to earn based on their contributions and achievements.

Axie Infinity is a notable example of a play-to-earn GameFi project. Players breed, battle, and trade fantasy creatures called axies, earning cryptocurrency rewards in return. The concept has gained popularity, contributing to the rise of decentralised gaming ecosystems in which players actively engage, not just for entertainment, but also for financial gains.

Cryptocurrency and eSports

ESports and cryptocurrency have intertwined in several ways, influencing the gaming industry and creating new opportunities for players and fans. Here are vital aspects of the relationship between eSports and cryptocurrency:

cryptocurrency sponsorships. Many eSports teams and tournaments have secured sponsorships and partnerships with cryptocurrency-related companies. These can include crypto exchanges, blockchain platforms, and projects launching their tokens.

In-game transactions and virtual assets: blockchain technology, often powered by cryptocurrencies, creates and manages in-game items. This gives players actual ownership and the ability to securely trade or sell virtual assets.

NFTs in eSports: non-fungible tokens (NFTs) have entered the eSports scene, representing unique in-game items, collectibles, or even moments from tournaments. Fans can purchase, trade, and own these NFTs.

Fan engagement and betting: cryptocurrencies are increasingly used for eSports betting platforms. Fans can place bets on tournament outcomes, match results, or other in-game events using cryptocurrencies.

Fan tokens: certain eSports teams have issued fan tokens on blockchain platforms. These tokens give fans voting rights on team decisions, exclusive content, and sometimes even in-game perks.

ESports tokenization: some eSports teams explore tokenisation, allowing fans to invest in the team by purchasing team-specific tokens. This provides a new form of fan engagement and financial support.

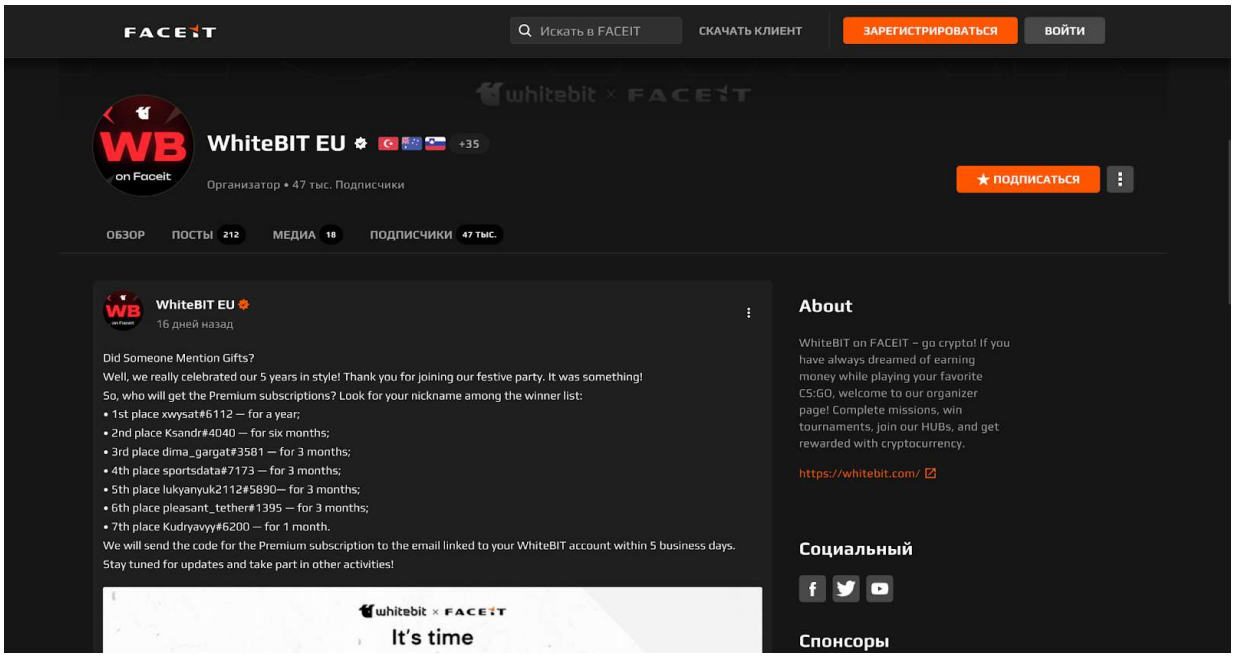
Crypto-focused esports tournaments: cryptocurrency companies occasionally organise eSports tournaments, offering crypto prizes to winners. These events attract attention from both the gaming and cryptocurrency communities.

Blockchain-based platforms: blockchain-based gaming platforms aim to create decentralised ecosystems in which players have greater control over their in-game assets and can participate in various gaming activities using cryptocurrencies.

WhiteBIT provides a tangible example of cryptocurrency integration into the eSport industry. WhiteBIT has a partnership with the world's leading esports company ESL FACEIT Group. As part of this collaboration, WhiteBIT provides the gaming community with several special events and activities that give users an easy start and access to the rapidly growing world of cryptocurrency. Hence, FACEIT users can access new CS:GO missions and events within the WhiteBIT HUB EU, WhiteBIT HUB EU EAST, and WhiteBIT HUB LATAM communities.

WhiteBIT and Faceit have held trading competitions, NFT collaborations, and more for almost two years (WhiteBIT, 2022b). On the exchange's 5th anniversary, newly registered users could receive a premium subscription to Faceit by logging in to WhiteBIT.

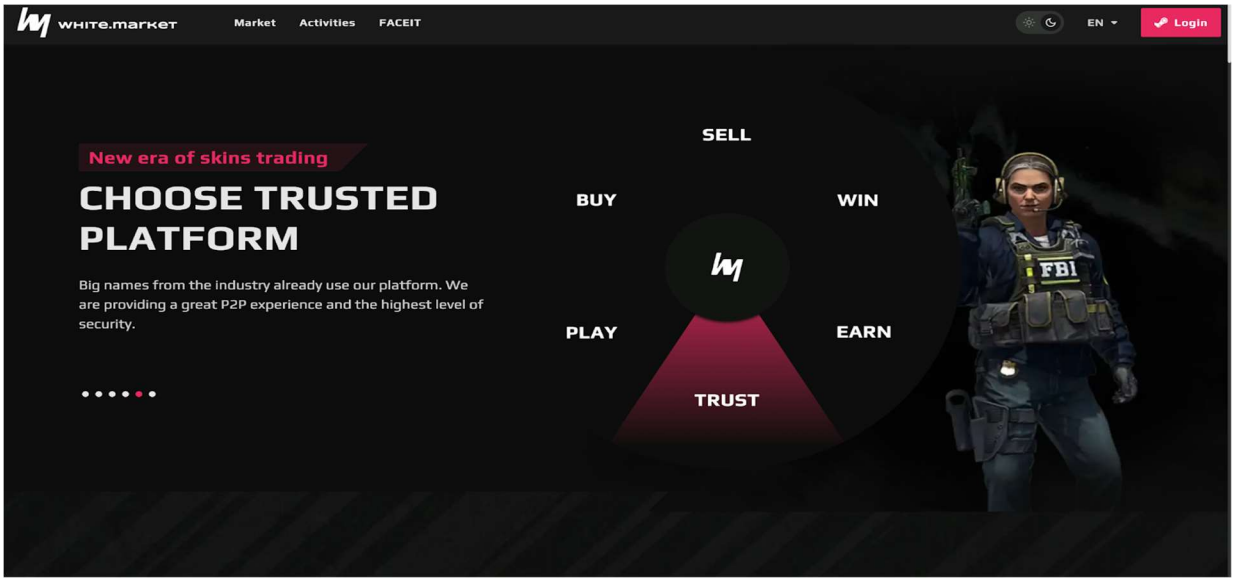
Figure 8. FaceIT (M3-U2-3)



Source: Own Source. Created by the author for this module

Another collaboration project of WhiteBIT is white.market skins marketplace, a product that unites the eSports and blockchain industries. white.marketis a platform for trading skins while enjoying better prices and lower fees than other platforms.

Figure 9. white.market(M4-U2-4)



Source: Own Source. Created by the author for this module.

The way GameFi works

Smart contracts form the backbone of GameFi platforms, executing predefined actions automatically when specific conditions are met. These contracts, known for their

flexibility and programmability, empower the creation of unique and innovative gaming experiences within the GameFi realm.

Each game typically employs multiple smart contracts, each serving a distinct function. For instance, one contract might manage in-game asset creation and distribution, another handles player rewards, and a third one oversees asset trading and the in-game economy.

GameFi development: a win-win for developers and users

Game developers can leverage the P2E model to establish new revenue streams and incentivise user engagement. This approach also attracts a dedicated user base comprising gamers, traders, and investors, offering a fertile ground for innovation.

Some platforms reward developers and investors with a share of transaction fees generated when players trade, sell, or stake their digital assets within the GameFi ecosystem. Analysts at Cryptonews.com predict that GameFi will become a dominant force in the crypto sector, reaching an estimated valuation of $104.5 billion by 2028 (Cooling, 2023).

Exploring popular GameFi activities

Creating and selling virtual assets: gamers can design unique in-game items, such as digital pets or virtual real estate, and trade them with other players.

Trading: players can trade in-game virtual assets, appealing to those interested in collecting rare or unique items.

Staking: some GameFi platforms enable players to stake digital assets, earning passive income while contributing to a game's governance or specific in-game activities.

GameFi risks

Despite its popularity, GameFi faces controversies related to environmental, social, and governance (ESG) risks. Environmental concerns, such as the energy consumption of blockchain networks, have sparked debates. As GameFi evolves, regulators will likely address concerns and implement safeguards to ensure compliance with local laws.

Embarking on your gameFi journey

Earning through GameFi demands skill, strategy, and a touch of luck. To navigate this exciting space, researching reputable platforms and understanding their tokenomics is

crucial. Starting small, testing withdrawal procedures, and assessing platform reliability are recommended for newcomers.

Creating an account involves providing essential information and setting up a wallet address. Cashing out earnings varies by platform, with withdrawal limits and fees influencing the process. As GameFi continues to reshape the gaming and financial landscape, prudent exploration and adherence to best practices ensure a rewarding experience.

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